


WINGET



FAULT CODE LISTING FOR ZF WG110 TRANSMISSION

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ZF FRIEDRICHSHAFEN Aktiengesellschaft					
Benennung: fault codes	Nr.:	DIN A4	Seite 1 von 24		
Zusatzbenennung: description of fault codes for Ergo control					
Diese technische Unterlage darf weder kopiert noch dritten Personen ohne unsere Erlaubnis mitgeteilt werden.	7				
	Index	Nr.	Datum	Name	Film
K3 ZFN 904	Ä N D E R U N G E N				
Erstellt: Name: Sommer Norbert Abteilung: TE-A Datum: 97-11-21	Geprüft:		Freigegeben :		

Description
 of the
 fault codes
 for
ERGO-Control EST37
 Used on the
WINGET ADT10
 Dump Truck

*Codes Marked in **BLUE** require **SERVICE ENGINEERS** intervention*

*Codes Marked in **YELLOW** can be solved by the **OPERATOR***

Index of changes:

Date	comment
97-12-12	first document based on error.doc dated 97-11-03
98-03-18	corrections
98-04-02	adjusted for document automation
98-05-04	inserted internal faultcode-numbers, completed reaction of TCU for s.c to Battery at K1..KR
98-05-15	inserted fault code F6
98-05-25	inserted fault code BB, BD .. BF
98-07-08	inserted fault code for additional customer specific functions
98-07-24	add customer Sisu
98-09-07	inserted fault code 15
98-10-06	add description of conditions for taking faults back
98-10-20	overlie fault code 55 for DeviceNet replace retarder request signal with aeb request signal, retarder request was not used
99-02-09	inserted internal faultcode-number 173 and 174, add customer Kalmar, add fault code for difflock
99-08-05	7 add display description

1 Introduction

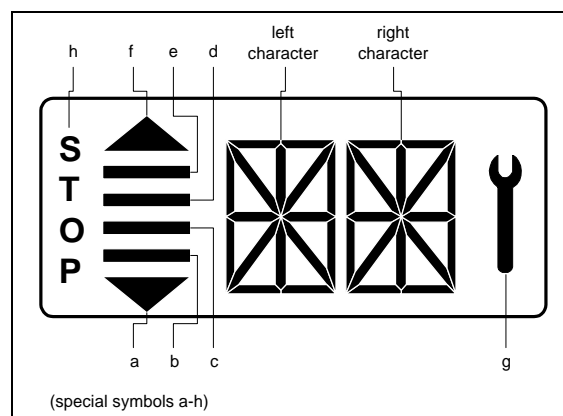
1.1 Abbreviations

o.c.	open circuit
s.c.	short circuit
OP-Mode	operating mode
TCU	transmission control unit
EEC	electronic engine controller
PTO	power take off

1.2 ZF - Display:

If a fault is detected, the display shows a spanner symbol (g) for a fault. The display shows the fault code, if the gear selector is on neutral position.

If more than one fault is detected, each fault code is shown for about 1 second.



1.3 Display during operation

symbol	meaning	remarks
1F, 1R 2F, 2R 3F, 3R 4F 5F 6F LF, LR	actual gear and direction left digit shows actual gear right digit shows actual direction limp home gear	
F or R, no gear	Clutch Cutoff	
F od R flashing	only 6WG: direction F or R selected while turbine speed is too high, CAUTION gear will engage if turbine speed drops	
NN	not neutral, waiting for neutral after power up or a severe fault	go engage a gear, first move shift selector to neutral position and again to F or R position
**	oil temperature too low, no gear available	warm up engine / transmission
*N	oil temperature low, only one gear available	warm up engine / transmission

1 bar (special symbol)	manual mode 1. gear	
2 bars	manual mode 2. gear	
3 bars	manual mode 3. gear	
4 bars	manual mode 4. gear	
4 bars and 2 arrows	automatic mode	
bars flashing	6 WG: converter lockup clutch open 4 WG: Downshift mode activ	difference of engine and turbine speed above a certain limit and lockup clutch not activated
spanner	at least one fault activ	select neutral to get fault code displayed
fault code	see faultcode list	
WS	warning sump temperature	changes between actual gear/direction while driving, in neutral only displayed if no fault is detected (spanner)
WR	warning retarder temperature	changes between actual gear/direction while driving, in neutral only displayed if no fault is detected (spanner)
WT	warning torque converter temperature	changes between actual gear/direction while driving, in neutral only displayed if no fault is detected (spanner)
WE	warning high engine speed	changes between actual gear/direction while driving, in neutral only displayed if no fault is detected (spanner)
PN	direction F or R selected while parking brake engaged	transmission in neutral until parking brake is released CAUTION: vehicle starts to move after release of parking brake
F od R flashing	direction F or R selected while turbine speed is to high, CAUTION gear will engage if turbine speed drops	
EE flashing	no communication with display	checked wiring from TCU to display

1.4 Display during AEB-Mode

symbol	meaning	remarks
PL	AEB - Starter is plugged at the diagnostic plug	
ST	AEB-Starter-button is pressed	
K1..K4,KV,KR	calibrating clutch K1..K4,KV,KR	
_ and Kx	wait for start, initialization of clutch Kx, x: 1, 2, 3, 4, V, R	
≡ and Kx	fast fill time determination of clutch Kx	
= and Kx	compensating pressure determination of clutch Kx	
OK	calibration for all clutches finished	Transmissions stays in neutral, you have to restart the TCU (ignition off/on) after removing AEB-Starter
STOP	AEB canceled (activation stopped)	Transmissions stays in neutral, you have to restart the TCU (ignition off/on)
STOP and Kx	AEB stopped, clutch Kx can't be calibrated	Transmissions stays in neutral, you have to restart the TCU (ignition off/on)
Spanner and Kx	Kx couldn't be calibrated, AEB finished	Transmissions stays in neutral, you have to restart the TCU (ignition off/on)
↑ E	engine speed too low, -> raise engine speed	
↓ E	engine speed too high, -> lower engine speed	

↑ T	transmission oil temperature too low, -> heat up transmission	
↓ T	transmission oil temperature too high -> cool down transmission	
FT	transmission temperature not in defined range during calibration	Transmissions stays in neutral, you have to restart the TCU (ignition off/on)
FB	operating mode not NORMAL or transmission temperature sensor defective or storing of Calibrated values to EEPROM-has failed.	Transmissions stays in neutral, you have to restart the TCU (ignition off/on)
FO	Outputspeed_not_zero	Transmissions stays in neutral, you have to restart the TCU (ignition off/on)
FN	Shift lever not in Neutral position	Transmissions stays in neutral, you have to restart the TCU (ignition off/on)
FP	Parkbrake_not_applied	Transmissions stays in neutral, you have to restart the TCU (ignition off/on)
STOP	AEB - Starter was used incorrect or is defective	Transmissions stays in neutral, you have to restart the TCU (ignition off/on)

2 Definition of operating modes

NORMAL:

There's no failure detected in the transmission-system or the failure has no or slight effects on transmission control. TCU will work without or in special cases with little limitations. (see following table)

SUBSTITUTE CLUTCH CONTROL:

TCU can't change the gears or the direction under the control of the normal clutch modulation. TCU uses the substitute strategy for clutch control. All modulations are only time controlled. (Comparable with EST 25)

LIMP-HOME:

The detected failure in the system has strong limitations to transmission control. TCU can engage only one gear in each direction. In some cases only one direction will be possible.

TCU will shift the transmission into neutral at the first occurrence of the failure. First, the operator must shift the gear selector into neutral position.

If output speed is less than a threshold for neutral to gear and the operator shifts the gear selector into forward or reverse, the TCU will select the limp-home gear .

If output speed is less than a threshold for reversal speed and TCU has changed into the limp-home gear and the operator selects a shuttle shift, TCU will shift immediately into the limp-home gear of the selected direction.

If output speed is greater than the threshold, TCU will shift the transmission into neutral. The operator has to slow down the vehicle and must shift the gear selector into neutral position.

TRANSMISSION-SHUTDOWN:

TCU has detected a severe failure that disables control of the transmission.

TCU will shut off the solenoid valves for the clutches and also the common power supply (VPS1).

Transmission shifts to Neutral. The park brake will operate normally, also the other functions which use ADM 1 to ADM 8.

The operator has to slow down the vehicle. The transmission will stay in neutral.

TCU-SHUTDOWN:

TCU has detected a severe failure that disables control of system.

TCU will shut off all solenoid valves and also both common power supplies (VPS1, VPS2). The park brake will engage, also all functions are disabled which use ADM 1 to ADM 8.

The transmission will stay in neutral.

3 table of fault codes

Fault Code (hex)	MEANING OF THE FAULT CODE possible reason for fault detection	reaction of the TCU	possible steps to repair	remarks
11	LOGICAL ERROR AT GEAR RANGE SIGNAL TCU detected a wrong signal combination for the gear range <ul style="list-style-type: none"> • cable from shift lever to TCU is broken • cable is defective and is contacted to battery voltage or vehicle ground • shift lever is defective 	TCU shifts transmission to neutral OP-Mode: transmission shutdown	<ul style="list-style-type: none"> • check the cables from TCU to shift lever • check signal combinations of shift lever positions for gear range 	failure cannot be detected in systems with DW2/DW3 shift lever fault is taken back if TCU detects a valid signal for the position
12	LOGICAL ERROR AT DIRECTION SELECT SIGNAL TCU detected a wrong signal combination for the direction <ul style="list-style-type: none"> • cable from shift lever to TCU is broken • cable is defective and is contacted to battery voltage or vehicle ground • shift lever is defective 	TCU shifts transmission to neutral OP-Mode: transmission shutdown	<ul style="list-style-type: none"> • check the cables from TCU to shift lever • check signal combinations of shift lever positions F-N-R 	fault is taken back if TCU detects a valid signal for the direction at the shift lever
15	LOGICAL ERROR AT DIRECTION SELECT SIGNAL 2. SHIFT LEVER TCU detected a wrong signal combination for the direction <ul style="list-style-type: none"> • cable from shift lever 2 to TCU is broken • cable is defective and is contacted to battery voltage or vehicle ground • shift lever is defective 	TCU shifts transmission to neutral if selector activ OP-Mode: transmission shutdown if selector activ	<ul style="list-style-type: none"> • check the cables from TCU to shift lever 2 • check signal combinations of shift lever positions F-N-R 	fault is taken back if TCU detects a valid signal for the direction at the shift lever
16	LOGICAL ERROR AT AXLE CONNECTION feedback axle connection measured by	OP-Mode: normal	<ul style="list-style-type: none"> • check the cables from TCU to feedback axle connection switch 	

Fault Code (hex)	MEANING OF THE FAULT CODE possible reason for fault detection	reaction of the TCU	possible steps to repair	remarks
	<p>TCU and output signal axle connection don't fit</p> <ul style="list-style-type: none"> axle can't be connected or disconnected due to mechanical problem one of the cables from feedback axle connection -switch to TCU is broken 		<ul style="list-style-type: none"> check signals of the feedback axle connection switch 	
25	<p>S.C. TO BATTERY VOLTAGE OR O.C. AT TRANSMISSION SUMP TEMPERATURE SENSOR INPUT</p> <p>the measured voltage is too high:</p> <ul style="list-style-type: none"> cable is defective and is contacted to battery voltage cable has no connection to TCU temperature sensor has an internal defect connector pin is contacted to battery voltage or is broken 	<p>no reaction, TCU uses default temperature OP-Mode: normal</p>	<ul style="list-style-type: none"> check the cable from TCU to the sensor check the connectors check the temperature sensor 	
26	<p>S.C. TO GROUND AT TRANSMISSION SUMP TEMPERATURE SENSOR INPUT</p> <p>the measured voltage is too low:</p> <ul style="list-style-type: none"> cable is defective and is contacted to vehicle ground temperature sensor has an internal defect connector pin is contacted to vehicle ground 	<p>no reaction, TCU uses default temperature OP-Mode: normal</p>	<ul style="list-style-type: none"> check the cable from TCU to the sensor check the connectors check the temperature sensor 	
27	<p>S.C. TO BATTERY VOLTAGE OR O.C. AT CONVERTER OUTPUT TEMPERATURE SENSOR INPUT</p> <p>the measured voltage is too high:</p>	<p>no reaction, TCU uses default temperature OP-Mode: normal</p>	<ul style="list-style-type: none"> check the cable from TCU to the sensor check the connectors check the temperature sensor 	

Fault Code (hex)	MEANING OF THE FAULT CODE possible reason for fault detection	reaction of the TCU	possible steps to repair	remarks
	<ul style="list-style-type: none"> • cable is defective and is contacted to battery voltage • cable has no connection to TCU • temperature sensor has an internal defect • connector pin is contacted to battery voltage or is broken 			
28	<p>S.C. TO GROUND AT CONVERTER OUTPUT TEMPERATURE SENSOR INPUT the measured voltage is too low:</p> <ul style="list-style-type: none"> • cable is defective and is contacted to vehicle ground • temperature sensor has an internal defect • connector pin is contacted to vehicle ground 	<p>no reaction, TCU uses default temperature OP-Mode: normal</p>	<ul style="list-style-type: none"> • check the cable from TCU to the sensor • check the connectors • check the temperature sensor 	
31	<p>S.C. TO BATTERY VOLTAGE OR O.C. AT ENGINE SPEED INPUT TCU measures a voltage higher than 7.00 V at speed input pin</p> <ul style="list-style-type: none"> • cable is defective and is contacted to battery voltage • cable has no connection to TCU • speed sensor has an internal defect • connector pin is contacted to battery voltage or has no contact 	<p>OP-Mode: substitute clutch control</p>	<ul style="list-style-type: none"> • check the cable from TCU to the sensor • check the connectors • check the speed sensor 	
32	<p>S.C. TO GROUND AT ENGINE SPEED INPUT TCU measures a voltage less than 0.45V at speed input pin</p> <ul style="list-style-type: none"> • cable / connector is defective and is contacted to vehicle ground • speed sensor has an internal defect 	<p>OP-Mode: substitute clutch control</p>	<ul style="list-style-type: none"> • check the cable from TCU to the sensor • check the connectors • check the speed sensor 	

Fault Code (hex)	MEANING OF THE FAULT CODE possible reason for fault detection	reaction of the TCU	possible steps to repair	remarks
33	<p>LOGICAL ERROR AT ENGINE SPEED INPUT TCU measures a engine speed over a threshold and the next moment the measured speed is zero</p> <ul style="list-style-type: none"> • cable / connector is defective and has bad contact • speed sensor has an internal defect • sensor gap has the wrong size 	OP-Mode: substitute clutch control	<ul style="list-style-type: none"> • check the cable from TCU to the sensor • check the connectors • check the speed sensor • check the sensor gap 	This fault is reset after power up of TCU
34	<p>S.C. TO BATTERY VOLTAGE OR O.C. AT TURBINE SPEED INPUT TCU measures a voltage higher than 7.00 V at speed input pin</p> <ul style="list-style-type: none"> • cable is defective and is contacted to battery voltage • cable has no connection to TCU • speed sensor has an internal defect • connector pin is contacted to battery voltage or has no contact 	<p>OP-Mode: substitute clutch control if a failure is existing at output speed, TCU shifts to neutral OP-Mode: limp home</p>	<ul style="list-style-type: none"> • check the cable from TCU to the sensor • check the connectors • check the speed sensor 	
35	<p>S.C. TO GROUND AT TURBINE SPEED INPUT TCU measures a voltage less than 0.45V at speed input pin</p> <ul style="list-style-type: none"> • cable / connector is defective and is contacted to vehicle ground • speed sensor has an internal defect 	<p>OP-Mode: substitute clutch control if a failure is existing at output speed, TCU shifts to neutral OP-Mode: limp home</p>	<ul style="list-style-type: none"> • check the cable from TCU to the sensor • check the connectors • check the speed sensor 	
36	<p>LOGICAL ERROR AT TURBINE SPEED INPUT TCU measures a turbine speed over a threshold and at the next moment the measured speed is zero</p> <ul style="list-style-type: none"> • cable / connector is defective and 	<p>OP-Mode: substitute clutch control if a failure is existing at output speed, TCU shifts to neutral OP-Mode: limp home</p>	<ul style="list-style-type: none"> • check the cable from TCU to the sensor • check the connectors • check the speed sensor • check the sensor gap 	This fault is reset after power up of TCU

Fault Code (hex)	MEANING OF THE FAULT CODE possible reason for fault detection	reaction of the TCU	possible steps to repair	remarks
	<p><i>has bad contact</i></p> <ul style="list-style-type: none"> • <i>speed sensor has an internal defect</i> • <i>sensor gap has the wrong size</i> 			
37	<p>S.C. TO BATTERY VOLTAGE OR O.C. AT INTERNAL SPEED INPUT</p> <p>TCU measures a voltage higher than 7.00 V at speed input pin</p> <ul style="list-style-type: none"> • <i>cable is defective and is contacted to battery voltage</i> • <i>cable has no connection to TCU</i> • <i>speed sensor has an internal defect</i> • <i>connector pin is contacted to battery voltage or has no contact</i> 	OP-Mode: substitute clutch control	<ul style="list-style-type: none"> • check the cable from TCU to the sensor • check the connectors • check the speed sensor 	
38	<p>S.C. TO GROUND AT INTERNAL SPEED INPUT</p> <p>TCU measures a voltage less than 0.45V at speed input pin</p> <ul style="list-style-type: none"> • <i>cable / connector is defective and is contacted to vehicle ground</i> • <i>speed sensor has an internal defect</i> 	OP-Mode: substitute clutch control	<ul style="list-style-type: none"> • check the cable from TCU to the sensor • check the connectors • check the speed sensor 	
39	<p>LOGICAL ERROR AT INTERNAL SPEED INPUT</p> <p>TCU measures a internal speed over a threshold and at the next moment the measured speed is zero</p> <ul style="list-style-type: none"> • <i>cable / connector is defective and has bad contact</i> • <i>speed sensor has an internal defect</i> • <i>sensor gap has the wrong size</i> 	OP-Mode: substitute clutch control	<ul style="list-style-type: none"> • check the cable from TCU to the sensor • check the connectors • check the speed sensor • check the sensor gap 	This fault is reset after power up of TCU
3A	<p>S.C. TO BATTERY VOLTAGE OR O.C. AT OUTPUT SPEED INPUT</p>	<p>special mode for gear selection</p> <p>OP-Mode: substitute clutch</p>	<ul style="list-style-type: none"> • check the cable from TCU to the sensor • check the connectors 	

Fault Code (hex)	MEANING OF THE FAULT CODE possible reason for fault detection	reaction of the TCU	possible steps to repair	remarks
	<p>TCU measures a voltage higher than 12.5 V at speed input pin</p> <ul style="list-style-type: none"> • cable is defective and is contacted to battery voltage • cable has no connection to TCU • speed sensor has an internal defect • connector pin is contacted to battery voltage or has no contact 	<p>control if a failure is existing at turbine speed, TCU shifts to neutral OP-Mode: limp home</p>	<ul style="list-style-type: none"> • check the speed sensor 	
3B	<p>S.C. TO GROUND AT OUTPUT SPEED INPUT TCU measures a voltage less than 1.00V at speed input pin</p> <ul style="list-style-type: none"> • cable / connector is defective and is contacted to vehicle ground • speed sensor has an internal defect 	<p>special mode for gear selection OP-Mode: substitute clutch control if a failure is existing at turbine speed, TCU shifts to neutral OP-Mode: limp home</p>	<ul style="list-style-type: none"> • check the cable from TCU to the sensor • check the connectors • check the speed sensor 	
3C	<p>LOGICAL ERROR AT OUTPUT SPEED INPUT TCU measures a output speed over a threshold and at the next moment the measured speed is zero</p> <ul style="list-style-type: none"> • cable / connector is defective and has bad contact • speed sensor has an internal defect • sensor gap has the wrong size 	<p>special mode for gear selection OP-Mode: substitute clutch control if a failure is existing at turbine speed, TCU shifts to neutral OP-Mode: limp home</p>	<ul style="list-style-type: none"> • check the cable from TCU to the sensor • check the connectors • check the speed sensor • check the sensor gap 	This fault is reset after power up of TCU
3E	<p>OUTPUT SPEED ZERO DOESN'T FIT TO OTHER SPEED SIGNALS if transmission is not neutral and the shifting has finished, TCU measures outputspeed zero and turbine speed or internal speed not equal to zero.</p> <ul style="list-style-type: none"> • speed sensor has an internal defect • sensor gap has the wrong size 	<p>special mode for gear selection OP-Mode: substitute clutch control if a failure is existing at turbine speed, TCU shifts to neutral OP-Mode: limp home</p>	<ul style="list-style-type: none"> • check the sensor signal of output speed sensor • check the sensor gap of output speed sensor • check the cable from TCU to the sensor 	This fault is reset after power up of TCU

Fault Code (hex)	MEANING OF THE FAULT CODE possible reason for fault detection	reaction of the TCU	possible steps to repair	remarks
71	<p>S.C. TO BATTERY VOLTAGE AT CLUTCH K1</p> <p>the measured resistance value of the valve is out of limit, the voltage at K1 valve is too high.</p> <ul style="list-style-type: none"> • <i>cable / connector is defective and has contact to battery voltage</i> • <i>cable / connector is defective and has contact to another regulator output of the TCU</i> • <i>regulator has an internal defect</i> 	<p>TCU shifts to neutral OP-Mode: limp home if failure at another clutch is pending TCU shifts to neutral OP-Mode: TCU shutdown</p>	<ul style="list-style-type: none"> • check the cable from TCU to the gearbox • check the connectors from TCU to the gearbox • check the regulator resistance ¹⁾ • check internal wire harness of the gearbox 	<p>¹⁾ see chapter 4</p>
72	<p>S.C. TO GROUND AT CLUTCH K1</p> <p>the measured resistance value of the valve is out of limit, the voltage at K1 valve is too low.</p> <ul style="list-style-type: none"> • <i>cable / connector is defective and has contact to vehicle ground</i> • <i>regulator has an internal defect</i> 	<p>TCU shifts to neutral OP-Mode: limp home if failure at another clutch is pending TCU shifts to neutral OP-Mode: TCU shutdown</p>	<ul style="list-style-type: none"> • check the cable from TCU to the gearbox • check the connectors from gearbox to TCU • check the regulator resistance ¹⁾ • check internal wire harness of the gearbox 	<p>¹⁾ see chapter 4</p>
73	<p>O.C. AT CLUTCH K1</p> <p>the measured resistance value of the valve is out of limit.</p> <ul style="list-style-type: none"> • <i>cable / connector is defective and has no contact to TCU</i> • <i>regulator has an internal defect</i> 	<p>TCU shifts to neutral OP-Mode: limp home if failure at another clutch is pending TCU shifts to neutral OP-Mode: TCU shutdown</p>	<ul style="list-style-type: none"> • check the cable from TCU to the gearbox • check the connectors from gearbox to TCU • check the regulator resistance ¹⁾ • check internal wire harness of the gearbox 	<p>¹⁾ see chapter 4</p>
74	<p>S.C. TO BATTERY VOLTAGE AT CLUTCH K2</p> <p>the measured resistance value of the valve is out of limit, the voltage at K2 valve is too high.</p> <ul style="list-style-type: none"> • <i>cable / connector is defective and has contact to battery voltage</i> • <i>cable / connector is defective and</i> 	<p>TCU shifts to neutral OP-Mode: limp home if failure at another clutch is pending TCU shifts to neutral OP-Mode: TCU shutdown</p>	<ul style="list-style-type: none"> • check the cable from TCU to the gearbox • check the connectors from gearbox to TCU • check the regulator resistance ¹⁾ • check internal wire harness of the gearbox 	<p>¹⁾ see chapter 4</p>

Fault Code (hex)	MEANING OF THE FAULT CODE possible reason for fault detection	reaction of the TCU	possible steps to repair	remarks
	<p><i>has contact to another regulator output of the TCU</i></p> <ul style="list-style-type: none"> <i>regulator has an internal defect</i> 			
75	<p>S.C. TO GROUND AT CLUTCH K2 the measured resistance value of the valve is out of limit, the voltage at K2 valve is too low.</p> <ul style="list-style-type: none"> <i>cable / connector is defective and has contact to vehicle ground</i> <i>regulator has an internal defect</i> 	<p>TCU shifts to neutral OP-Mode: limp home if failure at another clutch is pending TCU shifts to neutral OP-Mode: TCU shutdown</p>	<ul style="list-style-type: none"> check the cable from TCU to the gearbox check the connectors from gearbox to TCU check the regulator resistance ¹⁾ check internal wire harness of the gearbox 	<p>¹⁾ see chapter 4</p>
76	<p>O.C. AT CLUTCH K2 the measured resistance value of the valve is out of limit.</p> <ul style="list-style-type: none"> <i>cable / connector is defective and has no contact to TCU</i> <i>regulator has an internal defect</i> 	<p>TCU shifts to neutral OP-Mode: limp home if failure at another clutch is pending TCU shifts to neutral OP-Mode: TCU shutdown</p>	<ul style="list-style-type: none"> check the cable from TCU to the gearbox check the connectors from gearbox to TCU check the regulator resistance ¹⁾ check internal wire harness of the gearbox 	<p>¹⁾ see chapter 4</p>
77	<p>S.C. TO BATTERY VOLTAGE AT CLUTCH K3 the measured resistance value of the valve is out of limit, the voltage at K3 valve is too high.</p> <ul style="list-style-type: none"> <i>cable / connector is defective and has contact to battery voltage</i> <i>cable / connector is defective and has contact to another regulator output of the TCU</i> <i>regulator has an internal defect</i> 	<p>TCU shifts to neutral OP-Mode: limp home if failure at another clutch is pending TCU shifts to neutral OP-Mode: TCU shutdown</p>	<ul style="list-style-type: none"> check the cable from TCU to the gearbox check the connectors from gearbox to TCU check the regulator resistance ¹⁾ check internal wire harness of the gearbox 	<p>¹⁾ see chapter 4</p>
78	<p>S.C. TO GROUND AT CLUTCH K3 the measured resistance value of the valve is out of limit, the voltage at K3 valve is too low.</p>	<p>TCU shifts to neutral OP-Mode: limp home if failure at another clutch is pending</p>	<ul style="list-style-type: none"> check the cable from TCU to the gearbox check the connectors from gearbox to TCU 	<p>¹⁾ see chapter 4</p>

Fault Code (hex)	MEANING OF THE FAULT CODE possible reason for fault detection	reaction of the TCU	possible steps to repair	remarks
	<ul style="list-style-type: none"> • <i>cable / connector is defective and has contact to vehicle ground</i> • <i>regulator has an internal defect</i> 	TCU shifts to neutral OP-Mode: TCU shutdown	<ul style="list-style-type: none"> • check the regulator resistance ¹⁾ • check internal wire harness of the gearbox 	
79	<p>O.C. AT CLUTCH K3 the measured resistance value of the valve is out of limit.</p> <ul style="list-style-type: none"> • <i>cable / connector is defective and has no contact to TCU</i> • <i>regulator has an internal defect</i> 	TCU shifts to neutral OP-Mode: limp home if failure at another clutch is pending TCU shifts to neutral OP-Mode: TCU shutdown	<ul style="list-style-type: none"> • check the cable from TCU to the gearbox • check the connectors from gearbox to TCU • check the regulator resistance ¹⁾ • check internal wire harness of the gearbox 	¹⁾ see chapter 4
81	<p>S.C. TO BATTERY VOLTAGE AT CLUTCH K4 the measured resistance value of the valve is out of limit, the voltage at K4 valve is too high.</p> <ul style="list-style-type: none"> • <i>cable / connector is defective and has contact to battery voltage</i> • <i>cable / connector is defective and has contact to another regulator output of the TCU</i> • <i>regulator has an internal defect</i> 	TCU shifts to neutral OP-Mode: limp home if failure at another clutch is pending TCU shifts to neutral OP-Mode: TCU shutdown	<ul style="list-style-type: none"> • check the cable from TCU to the gearbox • check the connectors from gearbox to TCU • check the regulator resistance ¹⁾ • check internal wire harness of the gearbox 	¹⁾ see chapter 4
82	<p>S.C. TO GROUND AT CLUTCH K4 the measured resistance value of the valve is out of limit, the voltage at K4 valve is too low.</p> <ul style="list-style-type: none"> • <i>cable / connector is defective and has contact to vehicle ground</i> • <i>regulator has an internal defect</i> 	TCU shifts to neutral OP-Mode: limp home if failure at another clutch is pending TCU shifts to neutral OP-Mode: TCU shutdown	<ul style="list-style-type: none"> • check the cable from TCU to the gearbox • check the connectors from gearbox to TCU • check the regulator resistance ¹⁾ • check internal wire harness of the gearbox 	¹⁾ see chapter 4
83	<p>O.C. AT CLUTCH K4 the measured resistance value of the valve is out of limit.</p> <ul style="list-style-type: none"> • <i>cable / connector is defective and</i> 	TCU shifts to neutral OP-Mode: limp home if failure at another clutch is pending	<ul style="list-style-type: none"> • check the cable from TCU to the gearbox • check the connectors from gearbox to TCU 	¹⁾ see chapter 4

Fault Code (hex)	MEANING OF THE FAULT CODE possible reason for fault detection	reaction of the TCU	possible steps to repair	remarks
	<p><i>has no contact to TCU</i></p> <ul style="list-style-type: none"> <i>regulator has an internal defect</i> 	<p>TCU shifts to neutral OP-Mode: TCU shutdown</p>	<ul style="list-style-type: none"> check the regulator resistance ¹⁾ check internal wire harness of the gearbox 	
84	<p>S.C. TO BATTERY VOLTAGE AT CLUTCH KV the measured resistance value of the valve is out of limit, the voltage at KV valve is too high.</p> <ul style="list-style-type: none"> <i>cable / connector is defective and has contact to battery voltage</i> <i>cable / connector is defective and has contact to another regulator output of the TCU</i> <i>regulator has an internal defect</i> 	<p>TCU shifts to neutral OP-Mode: limp home if failure at another clutch is pending TCU shifts to neutral OP-Mode: TCU shutdown</p>	<ul style="list-style-type: none"> check the cable from TCU to the gearbox check the connectors from gearbox to TCU check the regulator resistance ¹⁾ check internal wire harness of the gearbox 	¹⁾ see chapter 4
85	<p>S.C. TO GROUND AT CLUTCH KV the measured resistance value of the valve is out of limit, the voltage at KV valve is too low.</p> <ul style="list-style-type: none"> <i>cable / connector is defective and has contact to vehicle ground</i> <i>regulator has an internal defect</i> 	<p>TCU shifts to neutral OP-Mode: limp home if failure at another clutch is pending TCU shifts to neutral OP-Mode: TCU shutdown</p>	<ul style="list-style-type: none"> check the cable from TCU to the gearbox check the connectors from gearbox to TCU check the regulator resistance ¹⁾ check internal wire harness of the gearbox 	¹⁾ see chapter 4
86	<p>O.C. AT CLUTCH KV the measured resistance value of the valve is out of limit.</p> <ul style="list-style-type: none"> <i>cable / connector is defective and has no contact to TCU</i> <i>regulator has an internal defect</i> 	<p>TCU shifts to neutral OP-Mode: limp home if failure at another clutch is pending TCU shifts to neutral OP-Mode: TCU shutdown</p>	<ul style="list-style-type: none"> check the cable from TCU to the gearbox check the connectors from gearbox to TCU check the regulator resistance ¹⁾ check internal wire harness of the gearbox 	¹⁾ see chapter 4
87	<p>S.C. TO BATTERY VOLTAGE AT CLUTCH KR the measured resistance value of the valve is out of limit, the voltage at KR valve is too high.</p>	<p>TCU shifts to neutral OP-Mode: limp home if failure at another clutch is pending TCU shifts to neutral</p>	<ul style="list-style-type: none"> check the cable from TCU to the gearbox check the connectors from gearbox to TCU check the regulator resistance ¹⁾ 	¹⁾ see chapter 4

Fault Code (hex)	MEANING OF THE FAULT CODE possible reason for fault detection	reaction of the TCU	possible steps to repair	remarks
	<ul style="list-style-type: none"> • cable / connector is defective and has contact to battery voltage • cable / connector is defective and has contact to another regulator output of the TCU • regulator has an internal defect 	OP-Mode: TCU shutdown	<ul style="list-style-type: none"> • check internal wire harness of the gearbox 	
88	<p>S.C. TO GROUND AT CLUTCH KR the measured resistance value of the valve is out of limit, the voltage at KR valve is too low.</p> <ul style="list-style-type: none"> • cable / connector is defective and has contact to vehicle ground • regulator has an internal defect 	<p>TCU shifts to neutral OP-Mode: limp home if failure at another clutch is pending TCU shifts to neutral OP-Mode: TCU shutdown</p>	<ul style="list-style-type: none"> • check the cable from TCU to the gearbox • check the connectors from gearbox to TCU • check the regulator resistance ¹⁾ • check internal wire harness of the gearbox 	¹⁾ see chapter 4
89	<p>O.C. AT CLUTCH KR the measured resistance value of the valve is out of limit.</p> <ul style="list-style-type: none"> • cable / connector is defective and has no contact to TCU • regulator has an internal defect 	<p>TCU shifts to neutral OP-Mode: limp home if failure at another clutch is pending TCU shifts to neutral OP-Mode: TCU shutdown</p>	<ul style="list-style-type: none"> • check the cable from TCU to the gearbox • check the connectors from gearbox to TCU • check the regulator resistance ¹⁾ • check internal wire harness of the gearbox 	¹⁾ see chapter 4
91	<p>S.C. TO GROUND AT RELAY REVERSE WARNING ALARM TCU detected a wrong voltage at the output pin, that looks like a s.c. to vehicle ground</p> <ul style="list-style-type: none"> • cable is defective and is contacted to vehicle ground • backup alarm device has an internal defect • connector pin is contacted to vehicle ground 	<p>backup alarm will be on until TCU power down even if fault vanishes (loose connection) OP-Mode: normal</p>	<ul style="list-style-type: none"> • check the cable from TCU to the backup alarm device • check the connectors from backup alarm device to TCU • check the resistance ¹⁾ of backup alarm device 	¹⁾ see chapter 4
92	S.C. TO BATTERY VOLTAGE AT RELAY	no reaction	<ul style="list-style-type: none"> • check the cable from TCU to the backup 	¹⁾ see chapter 4

Fault Code (hex)	MEANING OF THE FAULT CODE possible reason for fault detection	reaction of the TCU	possible steps to repair	remarks
	<p>REVERSE WARNING ALARM TCU detected a wrong voltage at the output pin, that looks like a s.c. to battery voltage</p> <ul style="list-style-type: none"> • cable is defective and is contacted to battery voltage • backup alarm device has an internal defect • connector pin is contacted to battery voltage 	<p>OP-Mode: normal</p>	<p>alarm device</p> <ul style="list-style-type: none"> • check the connectors from backup alarm device to TCU • check the resistance ¹⁾ of backup alarm device 	
93	<p>O.C. AT RELAY REVERSE WARNING ALARM TCU detected a wrong voltage at the output pin, that looks like a o.c. for this output pin</p> <ul style="list-style-type: none"> • cable is defective and has no connection to TCU • backup alarm device has an internal defect • connector has no connection to TCU 	<p>no reaction OP-Mode: normal</p>	<ul style="list-style-type: none"> • check the cable from TCU to the backup alarm device • check the connectors from backup alarm device to TCU • check the resistance ¹⁾ of backup alarm device 	<p>¹⁾ see chapter 4</p>
B1	<p>SLIPPAGE AT CLUTCH K1 TCU calculates a differential speed at closed clutch K1. If this calculated value is out of range, TCU interprets this as slipping clutch.</p> <ul style="list-style-type: none"> • low pressure at clutch K1 • low main pressure • wrong signal at internal speed sensor • wrong signal at output speed sensor • wrong size of the sensor gap • clutch is defective 	<p>TCU shifts to neutral OP-Mode: limp home if failure at another clutch is pending TCU shifts to neutral OP-Mode: TCU shutdown</p>	<ul style="list-style-type: none"> • check pressure at clutch K1 • check main pressure in the system • check sensor gap at internal speed sensor • check sensor gap at output speed sensor • check signal at internal speed sensor • check signal at output speed sensor • replace clutch 	

Fault Code (hex)	MEANING OF THE FAULT CODE possible reason for fault detection	reaction of the TCU	possible steps to repair	remarks
B2	<p>SLIPPAGE AT CLUTCH K2</p> <p>TCU calculates a differential speed at closed clutch K2. If this calculated value is out of range, TCU interprets this as slipping clutch.</p> <ul style="list-style-type: none"> • low pressure at clutch K2 • low main pressure • wrong signal at internal speed sensor • wrong signal at output speed sensor • wrong size of the sensor gap • clutch is defective 	<p>TCU shifts to neutral</p> <p>OP-Mode: limp home</p> <p>if failure at another clutch is pending</p> <p>TCU shifts to neutral</p> <p>OP-Mode: TCU shutdown</p>	<ul style="list-style-type: none"> • check pressure at clutch K2 • check main pressure in the system • check sensor gap at internal speed sensor • check sensor gap at output speed sensor • check signal at internal speed sensor • check signal at output speed sensor • replace clutch 	
B3	<p>SLIPPAGE AT CLUTCH K3</p> <p>TCU calculates a differential speed at closed clutch K3. If this calculated value is out of range, TCU interprets this as slipping clutch.</p> <ul style="list-style-type: none"> • low pressure at clutch K3 • low main pressure • wrong signal at internal speed sensor • wrong signal at output speed sensor • wrong size of the sensor gap • clutch is defective 	<p>TCU shifts to neutral</p> <p>OP-Mode: limp home</p> <p>if failure at another clutch is pending</p> <p>TCU shifts to neutral</p> <p>OP-Mode: TCU shutdown</p>	<ul style="list-style-type: none"> • check pressure at clutch K3 • check main pressure in the system • check sensor gap at internal speed sensor • check sensor gap at output speed sensor • check signal at internal speed sensor • check signal at output speed sensor • replace clutch 	
B4	<p>SLIPPAGE AT CLUTCH K4</p> <p>TCU calculated a difference speed at</p> <p>TCU calculates a differential speed at closed clutch K4. If this calculated value is out of range, TCU interprets this as slipping clutch.</p> <ul style="list-style-type: none"> • low pressure at clutch K4 • low main pressure • wrong signal at internal speed 	<p>TCU shifts to neutral</p> <p>OP-Mode: limp home</p> <p>if failure at another clutch is pending</p> <p>TCU shifts to neutral</p> <p>OP-Mode: TCU shutdown</p>	<ul style="list-style-type: none"> • check pressure at clutch K4 • check main pressure in the system • check sensor gap at internal speed sensor • check sensor gap at turbine speed sensor • check signal at internal speed sensor • check signal at turbine speed sensor • replace clutch 	

Fault Code (hex)	MEANING OF THE FAULT CODE possible reason for fault detection	reaction of the TCU	possible steps to repair	remarks
	<p><i>sensor</i></p> <ul style="list-style-type: none"> wrong signal at turbine speed sensor wrong size of the sensor gap clutch is defective 			
B5	<p>SLIPPAGE AT CLUTCH KV TCU calculates a differential speed at closed clutch KV. If this calculated value is out of range, TCU interprets this as slipping clutch.</p> <ul style="list-style-type: none"> low pressure at clutch KV low main pressure wrong signal at internal speed sensor wrong signal at turbine speed sensor wrong size of the sensor gap clutch is defective 	<p>TCU shifts to neutral OP-Mode: limp home if failure at another clutch is pending TCU shifts to neutral OP-Mode: TCU shutdown</p>	<ul style="list-style-type: none"> check pressure at clutch KV check main pressure in the system check sensor gap at internal speed sensor check sensor gap at turbine speed sensor check signal at internal speed sensor check signal at turbine speed sensor replace clutch 	
B6	<p>SLIPPAGE AT CLUTCH KR TCU calculates a differential speed at closed clutch KR. If this calculated value is out of range, TCU interprets this as slipping clutch.</p> <ul style="list-style-type: none"> low pressure at clutch KR low main pressure wrong signal at internal speed sensor wrong signal at turbine speed sensor wrong size of the sensor gap clutch is defective 	<p>TCU shifts to neutral OP-Mode: limp home if failure at another clutch is pending TCU shifts to neutral OP-Mode: TCU shutdown</p>	<ul style="list-style-type: none"> check pressure at clutch KR check main pressure in the system check sensor gap at internal speed sensor check sensor gap at turbine speed sensor check signal at internal speed sensor check signal at turbine speed sensor replace clutch 	
B7	<p>OVERTEMP SUMP TCU measured a temperature in the oil sump that is over the allowed threshold.</p>	<p>no reaction OP-Mode: normal</p>	<ul style="list-style-type: none"> cool down machine check oil level check temperature sensor 	

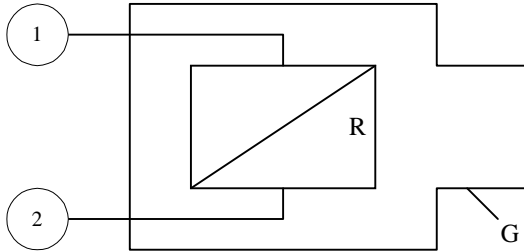
Fault Code (hex)	MEANING OF THE FAULT CODE possible reason for fault detection	reaction of the TCU	possible steps to repair	remarks
B8	OVERTEMP CONVERTER OUTPUT TCU measured a oil temperature at the converter ouput that is over the allowed threshold.	no reaction OP-Mode: normal	<ul style="list-style-type: none"> cool down machine check oil level check temperature sensor 	
BA	DIFFERENTIAL PRESSURE OIL FILTER TCU measured a voltage at differential pressure switch out of the allowed range <ul style="list-style-type: none"> oil filter is polluted cable/connector is broken or cable/connector is contacted to battery voltage or vehicle ground differential pressure switch is defective 	no reaction OP-Mode: normal	<ul style="list-style-type: none"> check oil filter check wiring from TCU to differential pressure switch check differential pressure switch (measure resitance) 	
D1	S.C. TO BATTERY VOLTAGE AT POWER SUPPLY FOR SENSORS TCU measures more than 6V at the pin AU1 (5V sensor supply)	see fault codes no. 21 to 2C	<ul style="list-style-type: none"> check cables and connectors to sensors, which are supplied from AU1 check the power supply at the pin AU1 (should be appx. 5V) 	fault codes no. 21 to no. 2C may be a reaction of this fault
D2	S.C. TO GROUND AT POWER SUPPLY FOR SENSORS TCU measures less than 4V at the pin AU1 (5V sensor supply)	see fault codes no. 21 to 2C	<ul style="list-style-type: none"> check cables and connectors to sensors, which are supplied from AU1 check the power supply at the pin AU1 (should be appx. 5V) 	fault codes no. 21 to no. 2C may be a reaction of this fault
D3	LOW POWER AT BATTERY measured voltage at power supply is lower than xx V	shift to neutral OP-Mode: TCU shutdown	<ul style="list-style-type: none"> check power supply battery check cables from batteries to TCU check connectors from batteries to TCU 	
D4	HIGH POWER AT BATTERY measured voltage at power supply is higher than xx V	shift to neutral OP-Mode: TCU shutdown	<ul style="list-style-type: none"> check power supply battery check cables from batteries to TCU check connectors from batteries to TCU 	
D5	ERROR AT SWITCH 1 FOR VALVE POWER SUPPLY VPS1	shift to neutral OP-Mode: TCU shutdown	<ul style="list-style-type: none"> check fuse check cables from gearbox to TCU 	

Fault Code (hex)	MEANING OF THE FAULT CODE possible reason for fault detection	reaction of the TCU	possible steps to repair	remarks
	<p>TCU switched on VPS1 and measured VPS1 is off or TCU switched off VPS1 and measured VPS1 is still on</p> <ul style="list-style-type: none"> • cable or connectors are defect and are contacted to battery voltage • cable or connectors are defect and are contacted to vehicle ground • permanent power supply KL30 missing • TCU has an internal defect 		<ul style="list-style-type: none"> • check connectors from gearbox to TCU • replace TCU 	
D6	<p>ERROR AT SWITCH 2 FOR VALVE POWER SUPPLY VPS2</p> <p>TCU switched on VPS2 and measured VPS2 is off or TCU switched off VPS2 and measured VPS2 is still on</p> <ul style="list-style-type: none"> • cable or connectors are defect and are contacted to battery voltage • cable or connectors are defect and are contacted to vehicle ground • permanent power supply KL30 missing • TCU has an internal defect 	<p>shift to neutral OP-Mode: TCU shutdown</p>	<ul style="list-style-type: none"> • check fuse • check cables from gearbox to TCU • check connectors from gearbox to TCU • replace TCU 	
E3	<p>S.C. TO BATTERY VOLTAGE AT DISPLAY OUTPUT</p> <p>TCU sends data to the display and measures allways a high voltage level on the connector</p> <ul style="list-style-type: none"> • cable or connectors are defective and are contacted to battery voltage • display has an internal defect 	<p>no reaction OP-Mode: normal</p>	<ul style="list-style-type: none"> • check the cable from TCU to the display • check the connectors at the display • change display 	
E4	<p>S.C. TO GROUND AT DISPLAY OUTPUT</p> <p>TCU sends data to the display and</p>	<p>no reaction OP-Mode: normal</p>	<ul style="list-style-type: none"> • check the cable from TCU to the display • check the connectors at the display 	

Fault Code (hex)	MEANING OF THE FAULT CODE possible reason for fault detection	reaction of the TCU	possible steps to repair	remarks
	measures allways a high voltage level on the connector • cable or connectors are defective and are contacted to vehicle ground • display has an internal defect		• change display	
F1	GENERAL EEPROM FAULT TCU can't read non volatile memory • TCU is defective	no reaction OP-Mode: normal	• replace TCU	often shown together with fault code F2
F3	APPLICATION ERROR something of this application is wrong	transmission stay neutral OP-Mode: TCU shutdown	• replace TCU !!	This fault occurs only if an test engineer did something wrong in the application of the vehicle
F5	CLUTCH FAILURE AEB was not able to adjust clutch filling parameters • One of the AEB-Values is out of limit	transmission stay neutral OP-Mode: TCU shutdown	• check clutch	TCU shows also the affected clutch on the Display
F6	CLUTCH ADJUSTMENT DATA LOST TCU was not able to read correct clutch adjustment parameters • interference during saving data on non volatile memory • TCU is brand new	no reaction, default values = 0 for AEB offsets used OP-Mode: normal	• execute AEB	

4 measuring of resistance at actuator/sensors and cable

4.1 actuator:



open circuit:

$$R_{12} \approx R_{1G} \approx R_{2G} \approx \infty$$

short cut to ground:

$$R_{12} \approx R; \quad R_{1G} \approx 0, R_{2G} \approx R \text{ or } R_{1G} \approx R, R_{2G} \approx 0$$

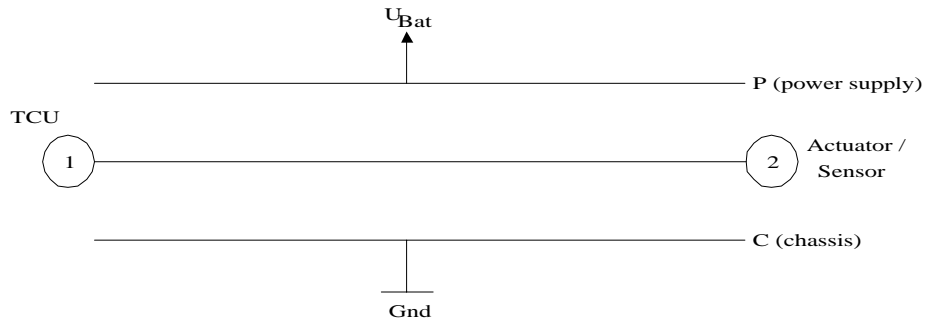
(for s.c. to ground, G is connected to vehicle ground)

short cut to battery:

$$R_{12} \approx R; \quad R_{1G} \approx 0, R_{2G} \approx R \text{ or } R_{1G} \approx R, R_{2G} \approx 0$$

(for s.c. to battery, G is connected to battery voltage)

4.2 cable:



open circuit:

$$R_{12} \approx R_{1P} \approx R_{1C} \approx R_{2P} \approx R_{2C} \approx \infty$$

short cut to ground:

$$R_{12} \approx 0; \quad R_{1C} \approx R_{2C} \approx 0, \quad R_{1P} \approx R_{2P} \approx \infty$$

short cut to battery:

$$R_{12} \approx 0; \quad R_{1C} \approx R_{2C} \approx \infty, \quad R_{1P} \approx R_{2P} \approx 0$$